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FOR: METHOD OF MANUFACTURING PLASMA DISPLAY PANEL

VERIFICATION OF A TRANSLATION

Assistant Commissioner for Patents
Washington, D.C. 20231
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I, the below named translator, hereby declare that:

1. My name and post office address are as stated below.

2. That I am knowledgeable in the English language and in the language of JP2003-044556, and I believe the attached English translation to be a true and complete translation of JP2003-044556.

3. The document for which the attached English translation is being submitted is a patent application on an invention entitled METHOD OF MANUFACTURING PLASMA DISPLAY PANEL.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and

belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: June 4, 2008

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(57) [Abstract]

[Object] In the PDP manufacturing method for forming a PDP structure by using a photolithography method, the object of the invention is to realize a plasma display panel manufacturing method capable of suppressing the generation of defects caused due to dust or the like sticking to the photo mask in the PDP structure.

[Means to Solve the Problems] The exposure in the photolithography method is performed two times, and between the first exposure and the second exposure, photo mask 22 is moved within an allowable range for deviation of exposure pattern.

When the exposure is performed two times in total before and after moving photo mask 22, it becomes possible to mostly eliminate region 21a not exposed to the light due to dust 22b sticking to photo mask 22. That is, it is possible to perform pattern exposure on sensitive Ag paste film 21.

[Selected Drawing] Fig. 2

[Claims]

[Claim 1]

A plasma display panel manufacturing method for forming a plasma display panel structure by using a photolithography method, wherein exposure is performed two times, and between first exposure and second exposure, a photo mask is moved within an allowable range for deviation of exposure pattern.

[Claim 2]

The plasma display panel manufacturing method of claim 1, wherein the photo mask is moved at least one period out of periodicity of exposure pattern, at which position the movement is within an allowable range for deviation of exposure pattern.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a plasma display panel manufacturing method for forming a plasma display panel (hereinafter referred to as PDP) structure known as a large-screen, thin, and light-weight display device.

[0002]

[Background Art]

In PDP, images are displayed in such manner that ultraviolet ray is generated by gas discharge, and phosphor is excited by the ultraviolet ray to emit light for the purpose of image display.

[0003]

PDP can be roughly classified into AC type and DC type in terms of drive, and into surface discharge type and opposed discharge type in terms of discharge. From the viewpoint of higher precision, larger screen size, and simplicity of the manufacture due to simplified structures, surface discharge type PDP having a three-electrode structure is mainly employed at present. The structure includes a substrate made of glass or the like on which a front panel having a display electrode formed of a scan electrode and a sustain electrode, a dielectric layer for covering it, and also a protective layer for covering it, and a rear panel having a plurality of address electrodes perpendicularly crossing the display electrode, a dielectric layer for covering it, and a partition wall on the dielectric layer are disposed opposite to each other, and thereby, a discharge cell is formed at the intersection between display electrode and data electrode, and the discharge cell is internally provided with a phosphor layer.

[0004]

Such PDP is, as compared with a liquid crystal panel, higher in display speed, wider in angle of view, easier to increase the size, higher in display quality because of self-emission type. For this reason, it is recently attracting special attention among flat panel display devices and is employed for various uses as a display device installed at a place where many peoples gather or a display device for enjoying pictures on a large screen at home.

[0005]

In the above configuration, the electrode such as a display electrode and/or address electrode is required to have sufficient accuracy with respect

to its shape and disposing pitch, and therefore, a material for example a conductive material such as a metallic material, containing a sensitive material, is applied to the entire surface of the substrate, and it is exposed to light by using a photo mask provided with electrode pattern, followed by development, that is, patterning by using a photolithography method, thereby forming an electrode having a predetermined shape in the specified position (e.g. refer to Non-patent document 1).

[0006]

[Non-patent document 1]

2001 full edition of FPD technology, Electronic Journal Co., Ltd. October 25, 2000, p589-594, p601-p603, p604-p607.

[0007]

[Problems to be Solved by the Invention]

In the photolithography method as described above, in case dust or the like sticks to the exposed portion of the photo mask, the sensitive material corresponding to the portion will not be exposed to the light nor polymerized, and as a result, it melts away during development and remains as a "dropout" portion, causing the generation of disconnection in the electrode.

[0008]

If disconnection takes place in the electrode, it is unable to feed power to the pixels on the down-stream side in the feeding direction depending upon the position of disconnection, and in PDP, it is a fatal defect because of causing hindrance to the image display.

[0009]

Described above is an example of electrode, but in PDP, the structure including a large screen is required to assure accuracy, and therefore, a photolithography method is sometimes employed similarly for forming the shape of partition wall for example other than electrodes, and in such a case, it sometimes causes hindrance to the image display the same as described above.

[0010]

The present invention is intended to solve such a problem, and in a PDP manufacturing method for forming the structure of PDP by using a photolithography method, and the object of the invention is to realize a plasma display panel manufacturing method capable of suppressing the generation of defects in the structure of PDP caused due to dust or the like sticking to the photo mask.

[0011]

[Means to Solve the Problems]

In order to achieve the above purpose, the plasma display panel manufacturing method of the present invention is a plasma display panel manufacturing method for forming the structure of a plasma display panel by using a photolithography method, wherein the exposure is performed two times, and between the first exposure and the second exposure, the photo mask is moved within an allowable range for deviation of exposure pattern.

[0012]

[Description of the Preferred Embodiments]

That is, the invention of claim 1 of the present invention is a plasma display panel manufacturing method for forming a plasma display panel

structure by using a photolithography method, wherein exposure is performed two times, and between first exposure and second exposure, a photo mask is moved within an allowable range for deviation of exposure pattern.

[0013]

Also, the invention of claim 2 is the invention of claim 1, wherein the photo mask is moved at least one period out of periodicity of exposure patterns, at which position the movement is within an allowable range for deviation of exposure pattern.

[0014]

The PDP manufacturing method in one preferred embodiment of the present invention will be described in the following with reference to the drawings.

[0015]

First, an example of PDP structure is described. Fig. 1 is sectional perspective view showing an example of the general structure of PDP which is manufactured by the PDP manufacturing method in one preferred embodiment of the present invention.

[0016]

Front panel 2 of PDP 1 is a structure including display electrode 6 formed of scan electrode 4 and sustain electrode 5 which are formed on one main surface of flat, transparent, and insulative substrate 3 at the front side such as glass obtained by a float method, shielding layer 7 disposed between adjacent display electrodes 6, dielectric layer 8 for covering display electrode 6 and shielding layer 7, and further, protective layer 9 made of MgO for

example which covers dielectric layer 8. Scan electrode 4 and sustain electrode 5 are structurally such that bus electrodes 4b, 5b formed from a highly conductive material such as a metallic material are laminated on transparent electrodes 4a, 5a for the purpose of reducing the electric resistance. Also, shielding layer 7 serves to shield white color from the phosphor layer (described later) during non- emission mode in order to enhance the contrast.

[0017]

Rear panel 10 is a structure including address electrode 12 formed on one main surface of flat, transparent, and insulative substrate 11 at the rear side such as glass obtained by a float method, dielectric layer 13 for covering address electrode 12, partition wall 14 in a place between adjacent address electrodes 12 on dielectric layer 13, and phosphor layers 15R, 15G, 15B between partition walls 14.

[0018]

And, front panel 2 and rear panel 10 are structurally such that display electrode 6 and address electrode 12 are perpendicularly opposed to each other with partition wall 14 therebetween and peripherally sealed with a sealing member. In discharge space 16 formed between front panel 2 and rear panel 10 is sealed for example Ne - Xe 5% discharge gas under pressure of 66.5 kPa (500 Torr).

[0019]

And, the intersection between display electrode 6 and address electrode 12 in discharge space 16 operates as discharge cell 17 (unit emission region).

[0020]

The manufacturing method for PDP 1 having a structure mentioned above will be described in the following with reference to Fig. 1.

[0021]

Front panel 2 is first formed with scan electrode 4 and sustain electrode 5 on substrate 3 for example in a stripe fashion. Specifically, a material for transparent electrode 4a, 5a, such as an ITO film, is formed on substrate 3 by using an electron beam evaporation method for example. Further, a resist is formed thereon by patterning so that it remains as patterns of transparent electrode 4a, 5a. After that, the film formed from the material for transparent electrode 4a, 5a is etched by etching, and thereafter, transparent electrodes 4a, 5a are formed by removing the resist. In this case, $SnO_2$ or the like can be used as a material for transparent electrodes. And, bus electrodes 4b, 5b are formed on transparent electrodes 4a, 5a formed as described above. Specifically, using a black sensitive paste including a black pigment. glass frit (based on $PbO \cdot B_2O_3 \cdot SiO_2$ or $Bi_2O_3 \cdot B_2O_3 \cdot SiO_2$), polymerization initiator, photo-curing monomer, and organic solvent, a black electrode film is formed on a glass substrate by a screen printing method or the like, followed by drying, and subsequently, using a sensitive Ag paste containing a Ag-contained conductive material, glass frit (based on $PbO \cdot B_2O_3 \cdot SiO_2$ or $Bi_2O_3 \cdot B_2O_3 \cdot SiO_2$), polymerization initiator, photo-curing monomer, and organic solvent, a metal electrode film is formed on the black electrode film by using a screen printing method, and dried again. After that, it is patterned by a photolithography method and burnt, and thereby, bus electrodes 4b, 5b can be formed. In this way,

display electrode 6 formed of scan electrode 4 and sustain electrode 5 can be formed.

[0022]

Next, shielding layer 7 is formed. It can be formed by patterning and burning by using a photolithography method after forming a layer of sensitive black paste by using a screen printing method or the like. Shielding layer 7 is preferable to be formed to gather with the surface black layer of bus electrode 4b, 5b. Also, it is allowable to use a method other than the forming method using a paste provided that the color is black. Also, it is preferable to form the layer before forming bus electrodes 4b, 5b.

[0023]

Next, display electrode 6 and shielding layer 7 formed as described above are covered with dielectric layer 8. Dielectric layer 8 is coated with a paste containing lead-based glass material by means of screen printing, and is formed into a layer having a predetermined thickness (about 20 $\mu$m) by burning at a specified temperature for a specified time (for example at 560℃ for 20 min.). As the paste containing lead-base glass material, for example, PbO (70wt%), $B_2O_3$ (15wt%), $SiO_2$ (10wt%), and a mixture of $Al_2O_3$ (5wt%) and organic binder (e.g. $\alpha$ - turpineole with 10% ethyl cellulose dissolved therein) are employed. Here, the organic binder is resin with organic solvent dissolved therein, and other than ethyl cellulose, acrylic resin can be used as the resin, while butyl carbitole can be used as the organic solvent. Further, it is preferable to mix a dispersing agent (e.g. glycertrioleate) in such an organic binder. Also, instead of screen printing by using a paste, it is preferable to laminate and burn a film-formed dielectric precursor.

[0024]

Dielectric layer 8 formed as described above is coated with protective layer 9. Protective layer 9 is, for example, made of MgO, which is formed into a layer having a predetermined thickness (about 0.5 $\mu$m) by a film forming process such as evaporation and sputtering.

[0025]

On the other hand, rear panel 10 is formed with address electrode 12 in a stripe fashion on substrate 11. Specifically, a material for address electrode 12, sensitive Ag paste for example, is used to form a layer on substrate 11 by using a screen printing method or the like, followed by patterning and burning by using a photolithography method.

[0026]

Next, address electrode 12 formed as described above is coated with dielectric layer 13. Dielectric layer 13 is coated with a paste containing lead-based glass material by screen printing for example, followed by burning at a specified temperature for specified time (e.g. for 560℃ for 20 min.), in order to form a layer having a predetermined thickness (about 20 $\mu$m). Also, instead of screen-printing the paste, it is preferable to laminate and burn a film-formed surface dielectric layer precursor.

[0027]

Next, partition wall 14 is formed in a stripe fashion for example. Partition wall 14 can be formed by forming a layer of sensitive paste based on aggregate such as $Al_2O_3$ and glass frit by using a printing method or die-coating method, followed by patterning and burning by using a photolithography method. Also, for example, it is preferable to repeatedly

coat a past containing lead-based glass material at a specified pitch by using a screen-printing method for example, followed by burning to form the layer. In this case, the gap size of partition wall 14 ranges, for example, from 130 $\mu$ m to 240 $\mu$ m in the case of HD - TV of 32 inches to 50 inches.

[0028]

And, phosphor layers 15R, 15G, 15B composed of phosphor particles of red (R), green (G), and blue (B) are formed in the groove between partition wall 14 and partition wall 14. That is, paste-like phosphor ink formed of phosphor particles of each color and an organic binder is coated thereon, and it is burnt at temperatures ranging from 400 to 590℃ to burn out the organic binder, thereby forming phosphor layers 15R, 15G, 15B with phosphor particles bonded to each other.

[0029]

Front panel 2 and rear panel 10 thus manufactured are laminated so that display electrode 6 of front panel 2 and address electrode 12 of rear panel 10 are perpendicular to each other, and a sealing member such as sealing glass is inserted in the periphery thereof, which is burnt for example at a temperature of about 450℃ for 10 to 20 minutes to form an air-tight sealing layer (not shown) for the purpose of sealing. And, after the inside of discharge space 16 is exhausted at a high vacuum level (e.g. 1, $1 \times 10^{-4}$ Pa), discharge gas (e.g. He - Xe based or Ne - Xe based inactive gas) is sealed under a specified pressure to manufacture PDP 1.

[0030]

Since PDP 1 is required to have a large screen and, at the same time, the structures of PDP 1 such as display electrode 6, shielding layer 7,

address electrode 12, and partition wall 14 are required to ensure accuracy with respect to the shape and position, a photolithography method is mainly employed as a method for forming such structures in the PDP 1 manufacturing method. Accordingly, a photolithography method in the PDP manufacturing method of the present invention will be described by using the drawings, mainly referring to the flow of a process for exposure, that is the characteristic feature of the present invention, taking the forming of address electrode 12 as an example. Fig. 2 is a schematic diagram showing a flow of the process for forming address electrode 12.

[0031]

As shown in Fig. 2 (a), using a sensitive Ag paste, it is uniformly coated by a screen printing method or the like to form sensitive Ag paste film 21.

[0032]

As shown in Fig. 2 (b), photo mask 22 having exposure pattern for obtaining address electrode 12 by using a photolithography method is positioned and disposed in the specified position. In Fig. 2 (b), the portion without hatching of photo mask 22 is opening, that is, exposure portion 22a. Also, it is supposed that dust 22b is sticking thereto.

[0033]

In this condition, as shown in Fig. 2 (c), the first exposure is performed on sensitive Ag paste film 21. Specifically, ultraviolet ray 23 is applied by means of an extra-high pressure mercury lamp. In this case, dust 22b is sticking to opening 22a of photo mask 22, and as a result, region 21a corresponding to dust 22b on sensitive Ag paste film 21 is not exposed to

the light.

[0034]

Subsequently, photo mask 22 is moved within the allowable range for deviation of exposure pattern, and then the second exposure is performed. Here, the allowable range for deviation of exposure patterns is an allowable range prescribed with respect to the accuracy of both shape and position of address electrode 12 to be formed.

[0035]

As for the method of making such a movement, the following can be mentioned such that as in the positional relation between opening 22a and dust 22b before and after the movement in Fig. 3, it is slightly moved within the allowable range for deviation of exposure patterns from the position of photo mask 22 during the first exposure as shown in Fig. 3 (a), or it is moved in the direction of elongation (lengthwise direction) so as to within the allowable range for deviation in the widthwise direction as shown in Fig. 3 (b) because address electrode 12 is striped, or it is moved more than one period carefully within the allowable range for deviation in the widthwise direction as shown in Fig. 3 (c) because address electrode 12 is disposed in a periodic fashion. In this case, the structure of PDP 1 configures discharge cell 17 that corresponds to pixel, and therefore, the arranging patterns are usually periodical. Also, the way of movement shown in Fig. 3 (a) is effective when it is supposed that dust 22b is smaller than any allowable range for deviation of exposure patterns. Figs. 3 (b), (c) are effective when it is supposed that dust 22b is larger than any allowable range for deviation of exposure pattern.

[0036]

Shown in Fig. 2 (d) is a state of photo mask 22 shown in Fig. 3 (c) moved for one period to the left from the state of Fig. 2 (c). As shown in Fig. 2 (d), photo mask 22 is moved within the allowable range for deviation of exposure pattern to perform the second exposure, and thereby, because of dust 22b sticking to exposure portion 22a of photo mask 22, even in case region 21a corresponding to dust 22b of sensitive Ag paste film 21 is not exposed to the light in the first exposure, the position corresponding to dust 22b on sensitive Ag paste film 21 changes during the second exposure, and therefore, region 21a not exposed to the light in the first exposure is then exposed to the light. Also, in the second exposure, region 21b not exposed to the light because the exposure light is obstructed by dust is generated at a position deviated for one period of exposure pattern, but region 21b has been already exposed to the light during the first exposure. That is, when photo mask 22 is moved, the probability of generation of dust at same position before and after the movement is very slight with respect to sensitive Ag paste film 21. Accordingly, at least by moving photo mask 22 and performing the exposure two times in total before and after the movement, it is possible to almost completely eliminate the region where the exposure light is obstructed resulting in failure of exposure due to dust 22b sticking to photo mask 22. That is, it becomes possible to reliably perform pattern exposure with respect to sensitive Ag paste film 21. Moreover, the accuracy of exposed pattern is within the allowable range of errors.

[0037]

And in this way, sensitive Ag paste film 21 with the pattern of

address electrode 12 exposed to the light is developed, thereby providing sensitive Ag paste film 21 with the pattern of address electrode 12, and it is burnt to make address electrode 12 completed.

[0038]

Described above is an example of address electrode 12, but it is also possible to obtain similar effects with respect to the structures of PDP 1 formed by using a photolithography method such as display electrode 6, shielding layer 7, address electrode 12, and partition wall 14.

[0039]

[Advantages of the Invention]

As described above, according to the present invention, in the PDP manufacturing method for forming the structure of PDP by using a photolithography method, it is possible to realize a plasma display panel manufacturing method capable of suppressing the generation of defect in the structure of PDP which is caused due to dust or the like sticking to the photo mask.

[Brief Description of the Drawings]

Fig.1 is a sectional perspective view showing an example of general configuration of PDP manufactured by the PDP manufacturing method in one preferred embodiment of the present invention.

Fig. 2 is a general flow chart of the process for forming address electrode 12.

Fig. 3 is a diagram showing an example of how to move the photo mask.

[Description of the Reference Numerals and Signs]

11 Substrate

21 Sensitive Ag paste film

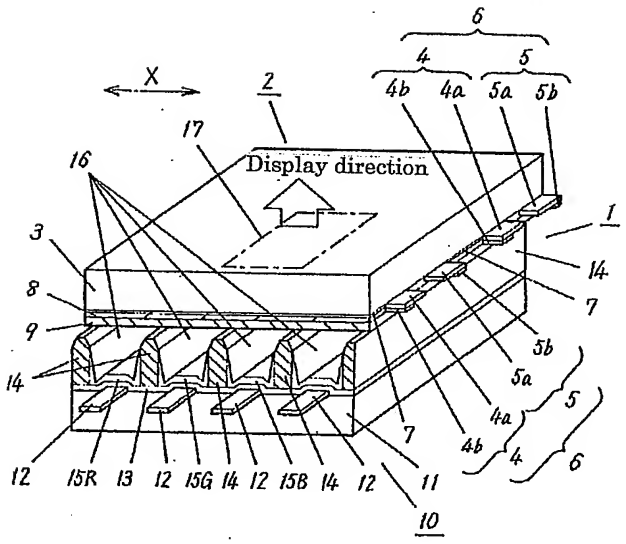
21a, 21b Region

22 Photo mask

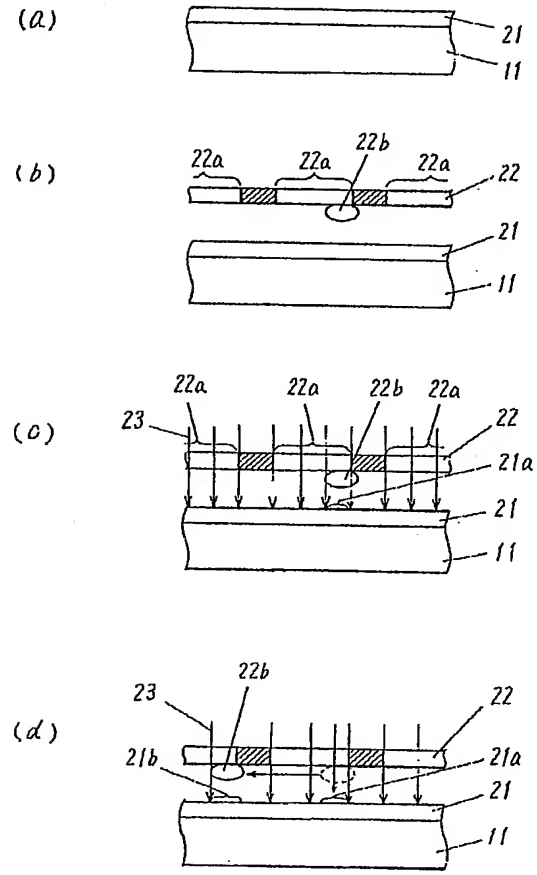
22a Exposure portion

22b Dust

[Fig. 1]




[Fig. 2]




[Fig. 3]